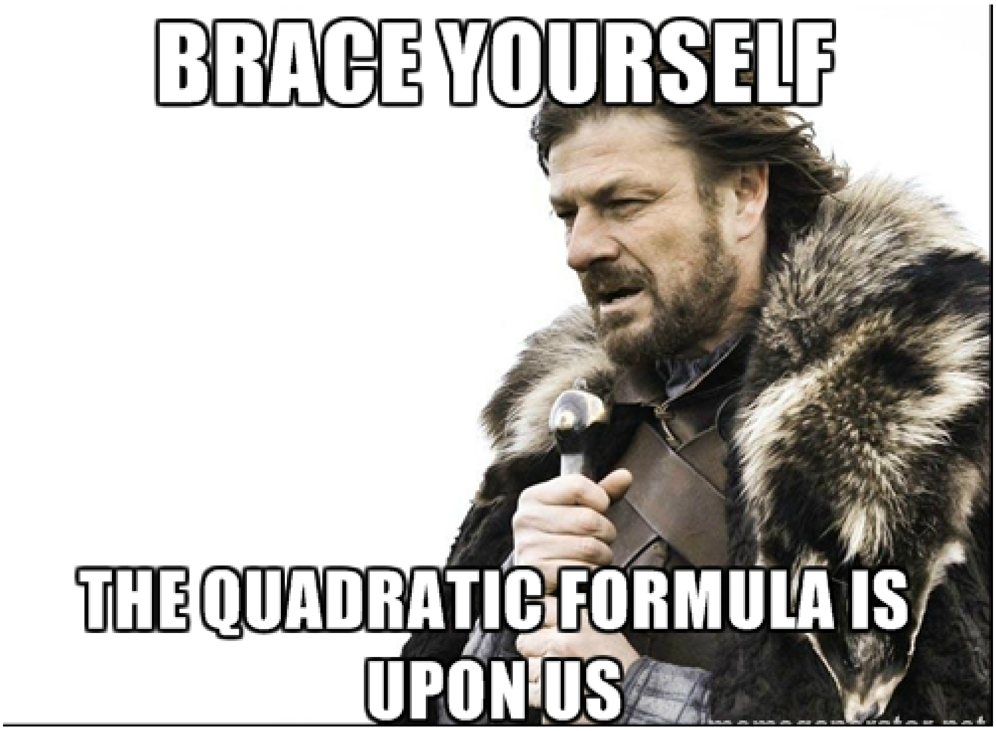
Good morning!

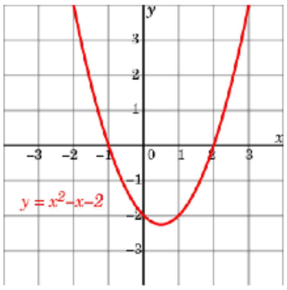
1. "Here"
2. Review discriminant
3. Develop the Quadratic Formula
4. Practice p. 22 of packet
5. Homework is on DeltaMath:)

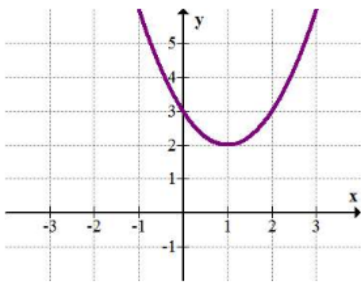

BRACE YOURSELF
THE QUADRATIC FORMULA IS UPON US

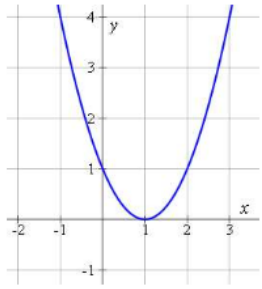
Quadratic Formula and the Discriminant

Remember, solutions to quadratic functions are also known as **zeroes, roots, and x-intercepts.**

How many solutions does each graph below have? *(think about the sentence above)*







The Discriminant

The discriminant is part of the quadratic formula. When you simplify the discriminant, it becomes a number that will tell you the number of solutions a quadratic function has.

Before finding the discriminant, you must make sure your equation is equal to zero

discriminant: $b^2 - 4ac$

If the discriminant is negative, there is/are no real solution

If the discriminant is zero, there is/are one solution

If the discriminant is positive, there is/are two solutions

For each equation below, determine the number of solutions.

1) $x^2 + 6x + 4 = 0$

2) $-3x^2 + 17x - 2 = 3$

3) $3x + 7 = -5x^2 - 4$

4) $x^2 - 5x - 34 = 0$

a = 1
b = -5
c = -34

$b^2 - 4ac$

$(-5)^2 - 4(1)(-34)$

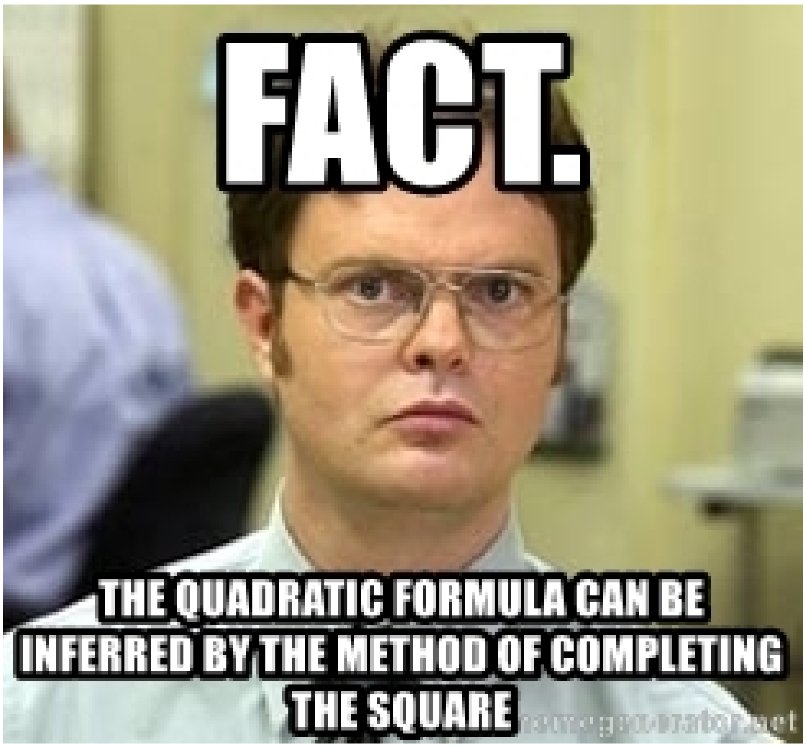
25 + 136

161

2 sol's

5) $2x^2 - 3x + 2 = 0$

6) $9x^2 + 24x + 10 = -6$


FACT.
THE QUADRATIC FORMULA CAN BE
INFERRED BY THE METHOD OF COMPLETING
THE SQUARE

$ax^2+bx+c=0$ standard form

$-c \quad -c$

$ax^2+bx=-c$

$a\left(x^2+\frac{b}{a}x+\frac{b^2}{4a^2}\right)=-c+a\frac{b^2}{4a^2}$

$a\left(x+\frac{b}{2a}\right)^2=-c+\frac{b^2}{4a}$

$\frac{a\left(x+\frac{b}{2a}\right)^2}{a}=\frac{-c}{a}+\frac{b^2}{4a^2}$

$\sqrt{\left(x+\frac{b}{2a}\right)^2}=\sqrt{-\frac{c}{a}+\frac{b^2}{4a^2}}$

$x+\frac{b}{2a}=\frac{\sqrt{b^2}}{\sqrt{4a^2}}-\frac{c\cdot 4a}{a\cdot 4a}$

$\sqrt{\frac{b^2-4ac}{4a^2}}$

$x+\frac{b}{2a}=\frac{\pm\sqrt{b^2-4ac}}{2a}$

$-\frac{b}{2a} \quad -\frac{b}{2a}$

$x=\frac{-b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$

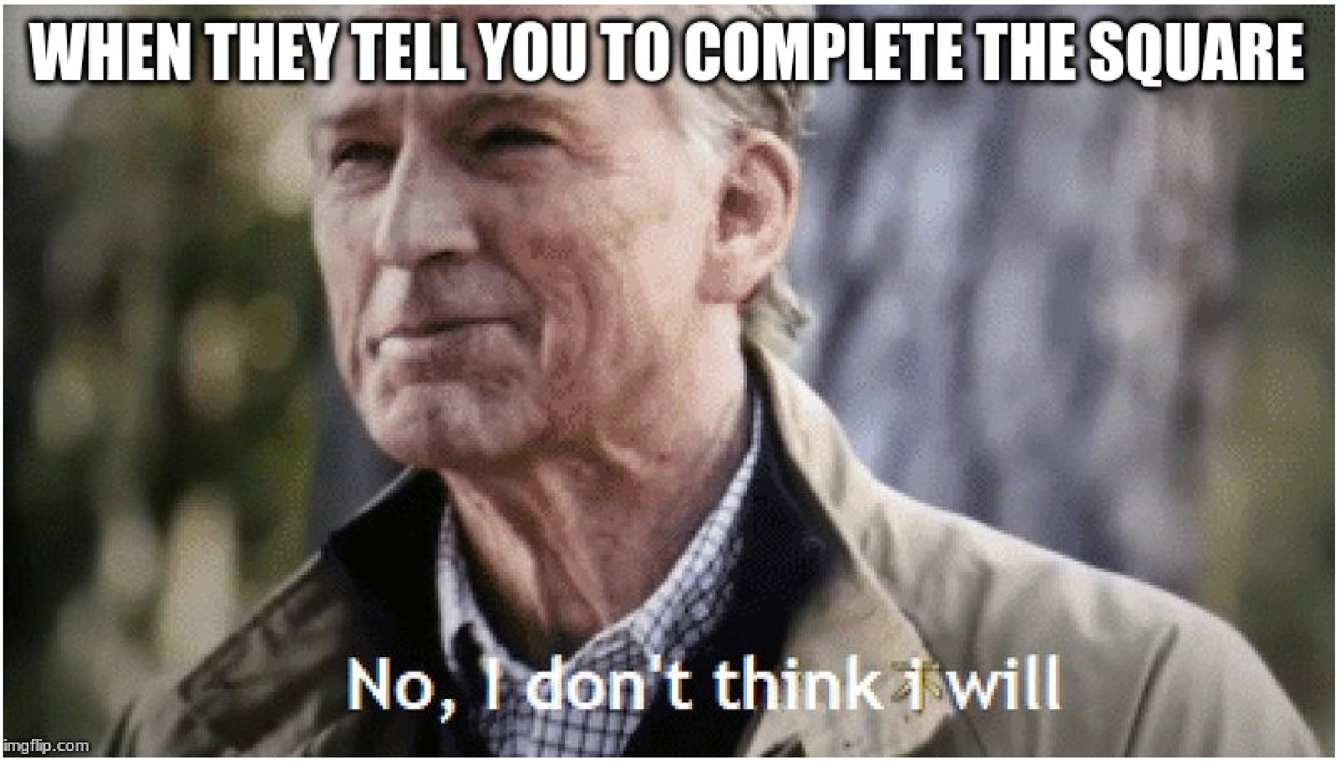
Quadratic formula

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$\frac{1}{2}\cdot\frac{b}{a}=\frac{b}{2a}$

$\frac{20}{5}=4$

$\frac{20}{2\cdot 5}=\frac{20}{10}=2$


WHEN THEY TELL YOU TO COMPLETE THE SQUARE
No, I don't think i will
imgflip.com

The Quadratic Formula

You can use the quadratic formula anytime that a quadratic equation is in general form. The quadratic formula is one method that will always work when solving quadratics.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Example: $4x^2 - 13x + 3 = 0$

Steps	Example
1) Find a, b, and c **make sure equation is set equal to zero**	a = 4 b = -13 c = 3
2) Plug a, b, and c into the quadratic formula	$x = \frac{-(-13) \pm \sqrt{(-13)^2 - 4(4)(3)}}{2(4)}$
3) Simplify the discriminant and denominator	$\frac{13 \pm \sqrt{121}}{8} = \frac{13 \pm 11}{8}$ 2(4) → 8 169 − 16(3), 169 − 48, 121 → 2 sol's
4) Separate into two equations and simplify	$x = \frac{13+11}{8} = \frac{24}{8}$, $x = 3$ $x = \frac{13-11}{8} = \frac{2}{8}$, $x = \frac{1}{4}$

Practice:

a = 1 b = 11 c = 10

1) $x^2 + 11x + 10 = 0$

Discriminant: 81 which means 2 solutions

Root(s): −1, −10

$$x = \frac{-(11) \pm \sqrt{(11)^2 - 4(1)(10)}}{2(1)}$$

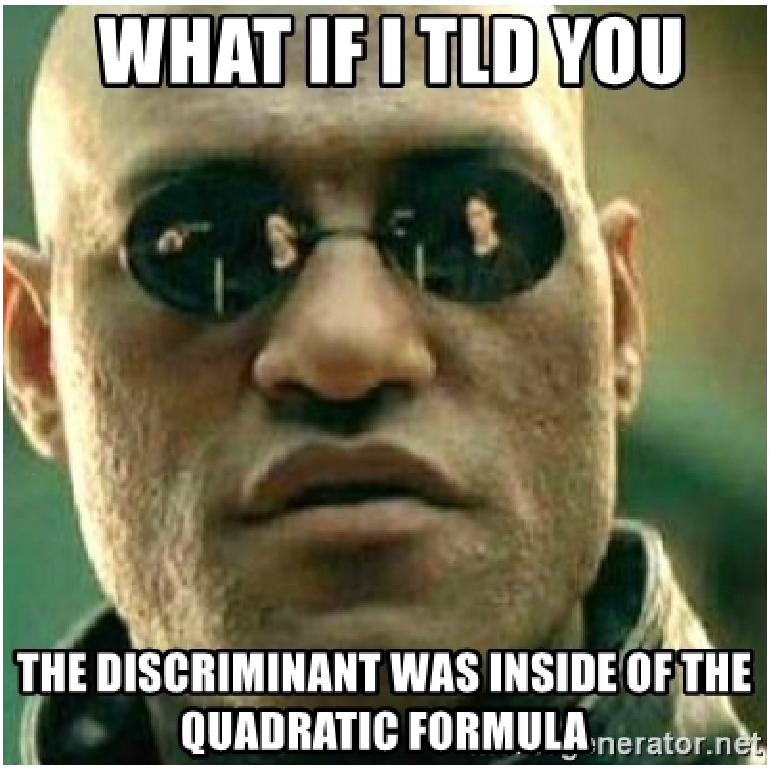
81

$$\frac{-11 \pm \sqrt{81}}{2}$$

$$\frac{-11 \pm 9}{2}$$

$x = \frac{-11+9}{2} = \frac{-2}{2}$, $x = -1$

$x = \frac{-11-9}{2} = \frac{-20}{2}$, $x = -10$


WHAT IF I TLD YOU
THE DISCRIMINANT WAS INSIDE OF THE
QUADRATIC FORMULA

$a=7$ $b=8$ $c=1$ ✓

2) $7x^2 + 8x + 1 = 0$

Discriminant: $8^2-4(7)(1)=64-28=36$

# of solutions: 2 solutions

Root(s): $-\frac{1}{7}$, -1

$$x=\frac{-(8)\pm\sqrt{(8)^2-4(7)(1)}}{2(7)}$$

$$x=\frac{-8\pm\sqrt{36}}{14}$$

$$x=\frac{-8+6}{14}$$

$$x=\frac{-2}{14}=\boxed{\frac{-1}{7}}$$

$$x=\frac{-8-6}{14}=\frac{-14}{14}$$

$$x=-1$$

$a=-3$ $b=2$ $c=8$

3) $-3x^2 + 2x = -8$ $\quad -3x^2+2x+8=0$ ($+8$ $+8$)

Discriminant: $2^2-4(-3)(8)$, $4+12(8)$, $4+96$, 100 — 2 solutions

# of solutions:

Root(s): $-4/3$, 2

$$x=\frac{-(2)\pm\sqrt{(2)^2-4(-3)(8)}}{2(-3)}$$

$$\frac{-2\pm\sqrt{100}}{-6}$$

$$x=\frac{-2+10}{-6}=\frac{8}{-6}$$

$$\boxed{x=-\frac{4}{3}}$$

$$x=\frac{-2-10}{-6}=\frac{-12}{-6}$$

$$\boxed{x=2}$$

$a=9$ $b=6$ $c=1$

4) $9x^2 + 6x + 1 = 0$

Discriminant: $6^2-4(9)(1)=0$

# of solutions: 1 solution

Root(s): $-\frac{1}{3}$

$$x=\frac{-(6)\pm\sqrt{(6)^2-4(9)(1)}}{2(9)}$$

$$x=\frac{-6\pm\sqrt{0}}{18}$$

$$x=\frac{-6}{18}=\boxed{\frac{-1}{3}=x}$$

5) $y = 9x^2 + 14x + 3$ $\quad a=9$ $b=14$ $c=3$

Discriminant: $14^2-4(9)(3)=196-108=88$

# of solutions: 2 solutions

Root(s): $\frac{-7\pm\sqrt{22}}{9}$, $\frac{-7+\sqrt{22}}{9}$, $\frac{-7-\sqrt{22}}{9}$

$$x=\frac{-(14)\pm\sqrt{(14)^2-4(9)(3)}}{2(9)}$$

$$=\frac{-14\pm\sqrt{88}}{18}$$

$\sqrt{88}$: $2 \cdot 44$, $44 = 2 \cdot 22$, $22 = 11 \cdot 2$ → $2\sqrt{22}$

$$x=\frac{-14\pm2\sqrt{22}}{18}$$

$$x=\frac{-14+2\sqrt{22}}{18}=\boxed{\frac{-7+\sqrt{22}}{9}} \text{ or } \frac{-7}{9}+\frac{\sqrt{22}}{9}$$

$$x=\frac{-14-2\sqrt{22}}{18}=\boxed{\frac{-7-\sqrt{22}}{9}} \text{ or } \frac{-7}{9}-\frac{\sqrt{22}}{9}$$

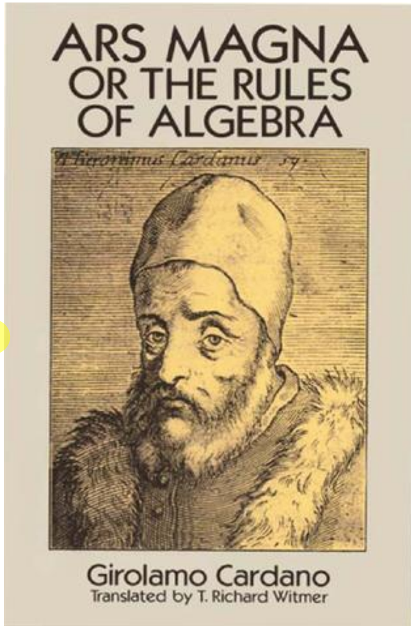
The Work of Al-Khwarizmi

The work of the Babylonians was lost for many years. In 825 CE, about 2,500 years after the Babylonian tablets were created, a general method that is similar to today's Quadratic Formula was authored by the Arab mathematician Muhammad bin Musa al-Khwarizmi in a book titled *Hisab al-jabr w'al-muqabala.* Al-Khwarizmi's techniques were more general than those of the Babylonians. He gave a method to solve any equation of the form $ax^2 + bx = c$, where a, b, and c are positive numbers. His book was very influential. The word "al-jabr" in the title of his book led to our modern word "algebra." Our word "algorithm" comes from al-Khwarizmi's name.

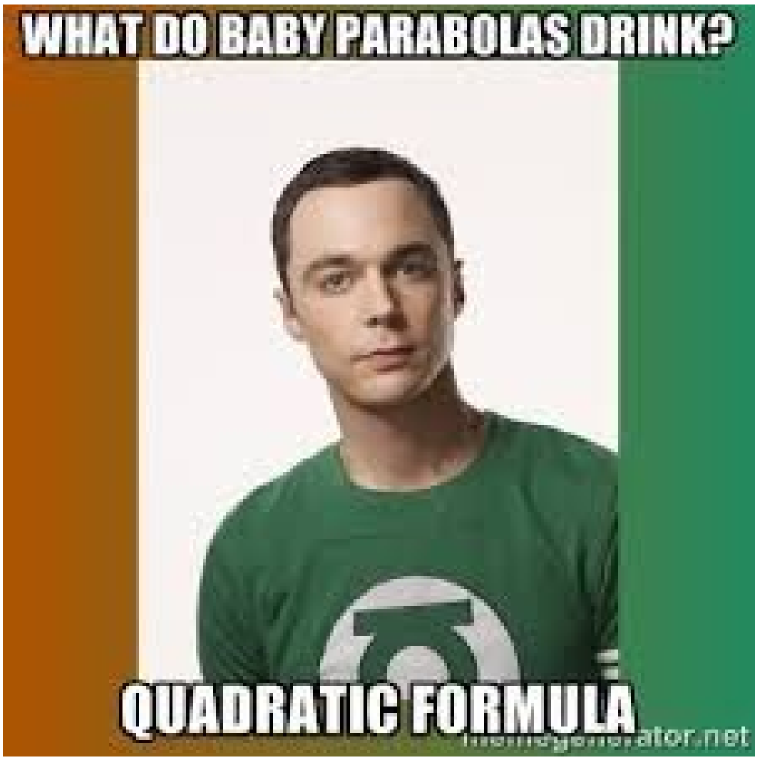
Muhammad bin Musa al-Khwarizmi

Neither the Babylonians nor al-Khwarizmi worked with an equation of the form $ax^2 + bx + c = 0$, because they considered only positive numbers, and if a, b, and c are positive, this equation has no positive solutions.

In 1545, a Renaissance scientist, Girolamo Cardano, blended al-Khwarizmi's solution with geometry to solve quadratic equations. He allowed negative solutions and even square roots of negative numbers that gave rise to complex numbers, a topic you will study in Advanced Algebra. In 1637, René Descartes published *La Géometrie* that contained the Quadratic Formula in the form we use today.



1500BC	Egyptians made a table.
580 BC	Pythagoras hates irrational numbers.
400 BC	Babylonians solved quadratic equations.
300 BC	Euclid developed a geometrical approach and proved that irrational numbers exist.
598-665AD	Brahmagupta took the Babylonian method that allowed the use of negative numbers.
800AD	Al-Khwarizmi removed the negative and wrote a book Hisab al-jabr w-al-musqagalah (Science of the Reunion and the Opposition)
1145AD	Abraham bar Hiyya Ha-Nasi (Savasaorda)wrote the book *Liber embadorum* –contained the complete solution to the quadratic equation.
1637AD	Rene Descartes published *La Geometrie* containing the quadratic formula we know today.


WHAT DO BABY PARABOLAS DRINK?
QUADRATIC FORMULA

What is a Metaphor?

Solve each equation below using the quadratic formula. Cross out the box that contains the solution set. When you finish, print the letters from the remaining boxes in the spaces at the bottom of the page.

1) $x^2 + 4x + 3 = 0$

2) $x^2 - 7x + 10 = 0$

3) $x^2 + 5x + 6 = 0$

4) $x^2 - 3x - 4 = 0$

5) $y^2 + 2y - 8 = 0$

6) $x^2 - 5x + 2 = 0$

7) $d^2 + 3d - 7 = 0$

8) $2x^2 - 5x + 2 = 0$

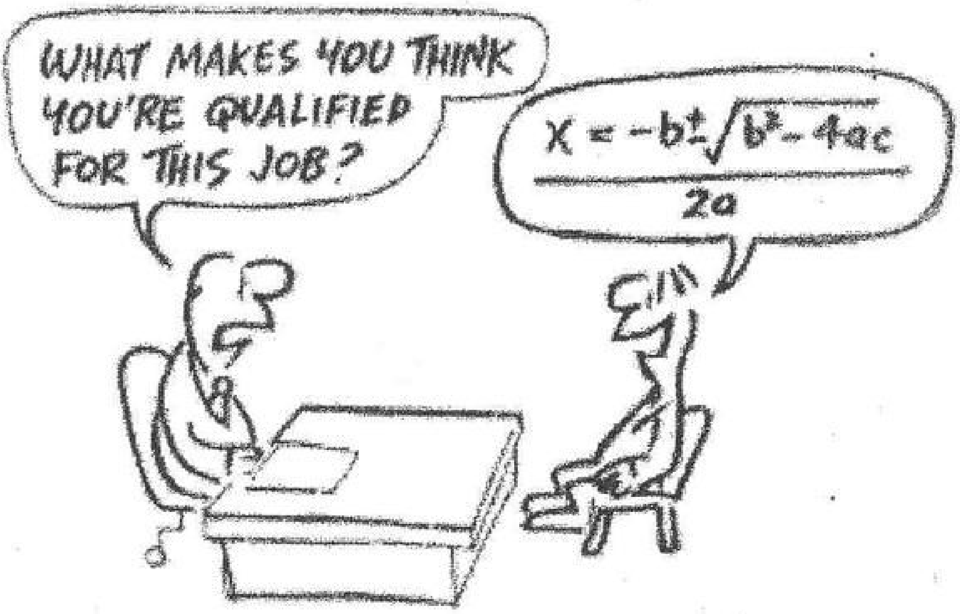
9) $2n^2 - 3n - 5 = 0$

10) $3x^2 + 5x + 1 = 0$

11) $3y^2 - 2y - 8 = 0$

ONE $\{5, 2\}$	ATH $\left\{\frac{-5 \pm \sqrt{13}}{6}\right\}$	TOK $\left\{-4, \frac{1}{2}\right\}$	ING $\left\{\frac{5}{2}, -1\right\}$	ICK $\left\{\frac{-3 \pm \sqrt{37}}{2}\right\}$
ASL $\{-2, -3\}$	EEP $\left\{\frac{3 \pm \sqrt{15}}{2}\right\}$	MET $\{2, -4\}$	BOW $\left\{2, -\frac{4}{3}\right\}$	COW $\left\{\frac{2 \pm \sqrt{30}}{6}\right\}$
BOY $\left\{2, \frac{1}{2}\right\}$	RIT $\{-1, -3\}$	SIN $\{6, 1\}$	GLE $\left\{\frac{5 \pm \sqrt{17}}{2}\right\}$	ING $\{4, -1\}$

Remaining Letters:


WHAT MAKES YOU THINK YOU'RE QUALIFIED FOR THIS JOB?
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$